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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/867,467	05/31/2001	Hiroyuki Nagasawa	209291US0	6872

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1765	13

DATE MAILED: 06/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

mx -13

Office Action Summary	Application No.	Applicant(s)	
	09/867,467	NAGASAWA ET AL.	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 March 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *9-11 and 13-24* is/are pending in the application.

4a) Of the above claim(s) *9-11* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *13-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Applicant's election with traverse of Group I in Paper No. 11 is acknowledged. The traversal is on the ground(s) that evidence has not been presented clearly showing the inventions are separate and distinct and a complete search of the relevant prior art only involves two subclasses. This is not found persuasive because a serious burden exists in the differing issues likely to arise during the prosecution of the different statutory classes of the invention. Also, the Examiner has demonstrated that the product as claimed can be made by another and materially different process, such as one not requiring changing partial pressure of source gases, which shows the inventions are distinct.

The requirement is still deemed proper and is therefore made FINAL.

Claim Objections

2. Claim 13 and 19 are objected to because of the following informalities: Claim 13 recites, "partial pressure ratio (pc2/ps) falls within the range of less than *once* the attachment coefficient" in line 11. The examiner suggests replacing "once" with "one times". Appropriate correction is required. Likewise for claim 19.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 13-15 and 19-21are rejected under 35 U.S.C. 103(a) as being unpatentable over Larkin et al (US 5,709,745).

Larkin et al discloses a method of forming a single crystal of Silicon Carbide (SiC) on a SiC substrate at a temperature of 1450°C using silane and propane source gases or other source gases may be used (col 22, ln 25-40, col 11, ln 35-50 and Claim 1). Larkin et al also discloses for p-type doping of crystals, the propane concentration was the only parameter varied (400-000 at. ppm) to effectively change the Si/C ratio within the growth reactor while the silane flow was held constant (col 22, ln 40-67). Larkin et al also discloses the growing of a SiC film is very sensitive to the ratio of silicon compound and carbon compound in the reaction chamber during crystal growth and by varying the ratio between 0.01 and 1, the impurity incorporation into the growing crystal film is controlled (col 11, ln 5-35 and col 14, ln 1-20). Larkin et al also discloses forming a pnp SiC crystal (col 18, ln 20-40).

Larkin et al discloses varying concentrations of source gases to control the impurity incorporation into a growing crystal film by changing the concentration of source gases added (Example 1). Larkin et al does not disclose varying partial pressures of source gases. However, the varying of partial pressure of source gases is a well known in the art as a method of controlling the concentration of elements in a vapor deposition apparatus, note Kisielowski et al (US 6,139,629) and Karapiperis et al (US 5,294,564) below, therefore controlling partial pressures is an equivalent method of controlling concentration to Larkin's method. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin

et al by changing the partial pressure of source gases to control the concentration of source gases in a deposition chamber because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

Larkin et al teaches a constant silane flow, this reads on applicant's ps, and varying propane between 400 and 000 at. ppm. A propane flow of 000 at. ppm, this reads on applicant's pc2, would inherently result in a pc2/ps ratio of less than one times the attachment coefficient because the ratio would be zero.

Larkin et al is silent to the partial pressure ratio pc1/ps falls within the range of 1-10 times the attachment coefficient, however Larkin et al discloses the Si to C ratio is between 0.01 and 1 (col 14, ln 1-10). Applicant discloses an embodiment in the instant application, where SiH_2Cl_2 is supplied at 10 sccm and C_2H_2 is supplied intermittently at 10 sccm [0028], which based on Larkin's teachings of concentration would be a ratio of Si/C ratio of 1:2 or 0.5 because C_2H_2 contains 2 carbon atoms. Therefore, a partial pressure ratio pc1/ps falls within the range of 1-10 times the attachment coefficient is inherent to Larkin et al because Larkin et al discloses a similar range of concentration, as applicant, for single crystal growth.

Referring to claim 13, Larkin et al teaches a temperature of 1450°C, a silane and propane source gas to form a SiC single crystal, and varying the Si/C ratio to form a pnp crystal and a constant silane flow and varying propane between 400-000 ppm.

Referring to claims 14 and 20, Larkin et al teaches Silane (SH_4) and propane (C_3H_8), note column 9, lines 25-40.

Referring to claims 15 and 21, Larkin et al teaches introducing vaporized compounds in a reaction chamber and maintaining proper material flow rates in the reaction chamber for a

sufficient time to grow a crystal film having a desired smooth surface morphology, uniform thickness, and a controlled impurity profile (col 11, ln 15-30), this is a teaching that time of material flow is a result effective variable. Larkin et al does not teach the timing of 0.1-30 seconds. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al by optimizing same by conducting routine experimentation of a result effective variable. The selection of reaction parameters such as temperature and concentration is obvious (In re Aller 105 USPQ 233, 255 (CCPA 1955)).

Referring to claim 19, Larkin et al teaches a temperature of 1450°C, a silane and propane source gas to form a SiC single crystal, and varying the Si/C ratio to form a pnp crystal and a constant silane flow and varying propane between 400-000 ppm. Larkin et al does not teach maintaining a constant carbon source gas flow and varying the silicon source gas flow. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al by having a constant carbon flow and a varying silicon flow, which is equivalent to varying the carbon flow and maintaining the silicon flow for adjusting the Si/C ratio. Substitution of known equivalents for the same purpose is held to be obvious. (MPEP 2144.06)

5. Claims 16-17 and 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larkin et al (US 5,709,745) as applied to claims 13-15 and 19-21above, and further in view of Sugiyama et al (US 5,964,944).

Larkin et al teaches all of the limitations of claim 16, as discussed previously, except the silicon carbide is employed as a seed crystal and silicon carbide is formed on the seed crystal by vapor phase epitaxy, sublimation recrystallization or liquid deposition.

In a method of producing silicon carbide single crystals by vapor phase epitaxy, note entire reference, Sugiyama et al teaches using large silicon carbide seed crystals, as large as 3-4 inches in diameter, in the production of a large size silicon carbide single crystal (col 5, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al with Sugiyama et al to produce larger silicon carbide crystals useful in the semiconductor industry at a low cost (col 1-67; col 2, ln 1-67). In regards to applicant's bore of 4-6 inches; overlapping ranges are held to be obvious (MPEP 2144.05).

6. Claims 18 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larkin et al (US 5,709,745) as applied to claims 13-15 and 19-21above, and further in view of Gardner (US 3,630,678).

Larkin et al teaches all of the limitations of claim 18, as discussed previously, except the silicon carbide is employed as a seed crystal and diamond and/or gallium nitride is formed on the seed crystal.

In a process for growing diamond, note entire reference, Gardner teaches a diamond grown on a silicon carbide seed with improved crystallinity grown using carbon containing gases (col 7, ln 1-67; col 1, ln 1-67; Claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Larkin et al with Gardner to produce diamonds, which are useful as abrasives and semiconductors (col 1, ln 1-25).

Response to Arguments

7. Applicant's arguments with respect to claims 13-24 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Karapiperis et al (US 5,294,564) teaches a reduction of a n-type dopant of Si, namely the partial pressure of SiH_4 in the gas phase in a vapor deposition (col 13, ln 10-60).

Kisielowski et al (US 6,139,629) teaches the concentration of Bi, Ga and Mg is determined by controlling the temperature of the evaporation source, which in turn determines the partial pressure of the element in a MBE chamber (col 4, ln 30-65).

Lerner (US 5,167,935) teaches the partial pressure of a component is directly proportional to its ppmv gas concentration (col 11, ln 30-45).

Dobson (US 4,666,565) teaches the concentration (partial pressure) of a reacting gas in a gas sample (col 4, ln 45-67).

Venkatesan et al (US 5,863,598) teaches gas flow rates may be used instead of partial pressures sine the partial pressure of a gas is related to its flow rate (col 8, ln 10-40).

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
May 30, 2003

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